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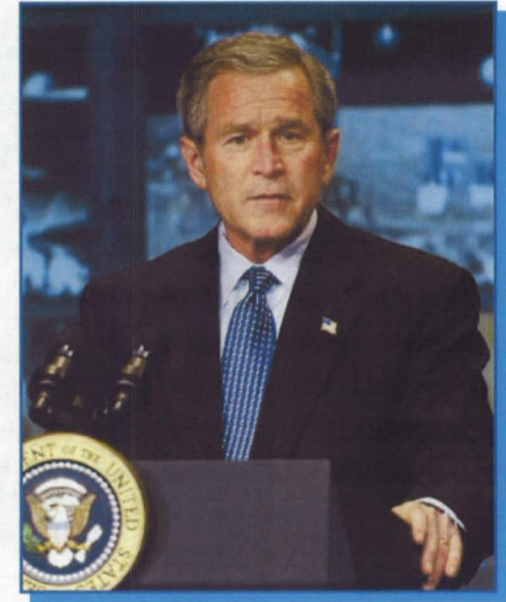
# Constellation Program SR&QA Overview



**Russ DeLoach**  
**KSC Constellation S&MA Project Office**

# A Vision for Space Exploration, Authorized by Congress

- ◆ **Complete the International Space Station**
- ◆ **Safely fly the Space Shuttle until 2010**
- ◆ **Develop and fly the Crew Exploration Vehicle (Orion) no later than 2014**
- ◆ **Return to the Moon no later than 2020**
- ◆ **Extend human presence across the solar system and beyond**
- ◆ **Implement a sustained and affordable human and robotic space program**
- ◆ **Develop supporting innovative technologies, knowledge, and infrastructures**
- ◆ **Promote international and commercial participation in exploration**

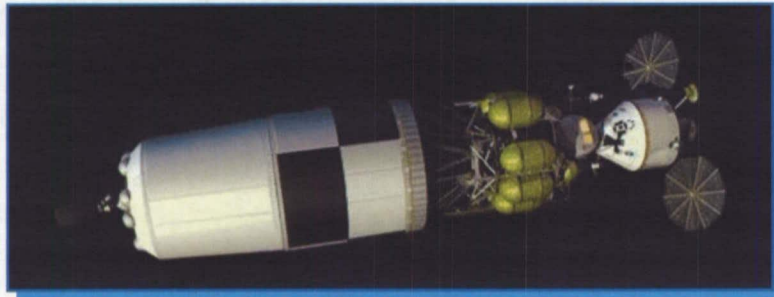


## NASA Authorization Act of 2005

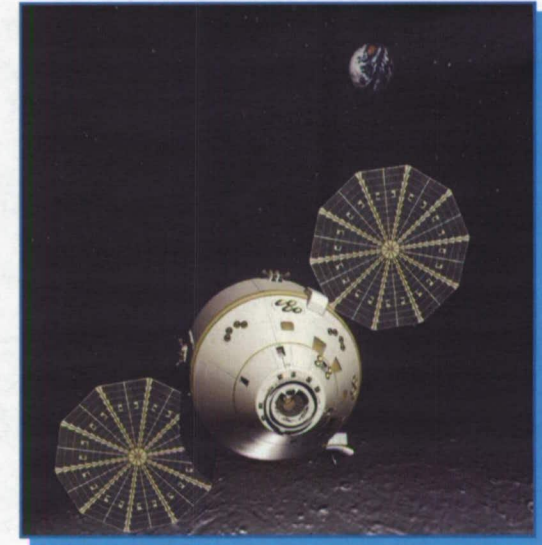
The Administrator shall establish a program to develop a sustained human presence on the Moon, including a robust precursor program to promote exploration, science, commerce and U.S. preeminence in space, and as a stepping stone to future exploration of Mars and other destinations.



# Components of Program Constellation



Earth  
Departure  
Stage



Orion – Crew  
Exploration  
Vehicle



Ares V -  
Heavy Lift  
Launch  
Vehicle



Ares I - Crew  
Launch Vehicle

Lunar  
Lander



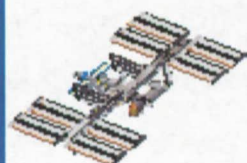








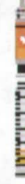






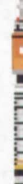






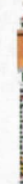
# Constellation Manifest

CR# C0000145A  
May 24, 2007



Test  
Flights



2009	2010	2011	2012	2013									
<div>Ares I-X</div> <div></div> <div>Apr</div>	<div>AA-1</div> <div></div> <div>Sep Max Q</div>	<div>AA-2</div> <div></div> <div>Aug Transonic</div>	<div>AA-3</div> <div></div> <div>Feb Off Nom Att</div>	<div>Ares I-Y</div> <div></div> <div>Sep</div> <div>Orion 1</div> <div></div> <div>Mar</div> <div>Orion 2</div> <div></div> <div>Sep ATLAS</div>									
2014	2015	2016	2017	2018	2019	2020							
<div>Orion 3</div> <div></div> <div>Mar ATLAS</div>	<div>Orion 4</div> <div></div> <div>Sep</div>	<div>Orion 5</div> <div></div> <div>Mar</div>	<div>Orion 6</div> <div></div> <div>Sep</div>	<div>Orion 7</div> <div></div> <div>Mar</div>	<div>Orion 8</div> <div></div> <div>Sep</div>	<div>Orion 9</div> <div></div> <div>Mar</div>	<div>Orion 10</div> <div></div> <div>Sep</div>	<div>Orion 11</div> <div></div> <div>Mar</div>	<div>Orion 12</div> <div></div> <div>Sep</div>	<div>Orion 14</div> <div></div> <div>Mar</div>	<div>Orion 16</div> <div></div> <div>Sep</div>	<div>Orion 18</div> <div></div> <div>Mar</div>	<div>Orion 20</div> <div></div> <div>Sep</div>






Legend

Manned

Unmanned

Test

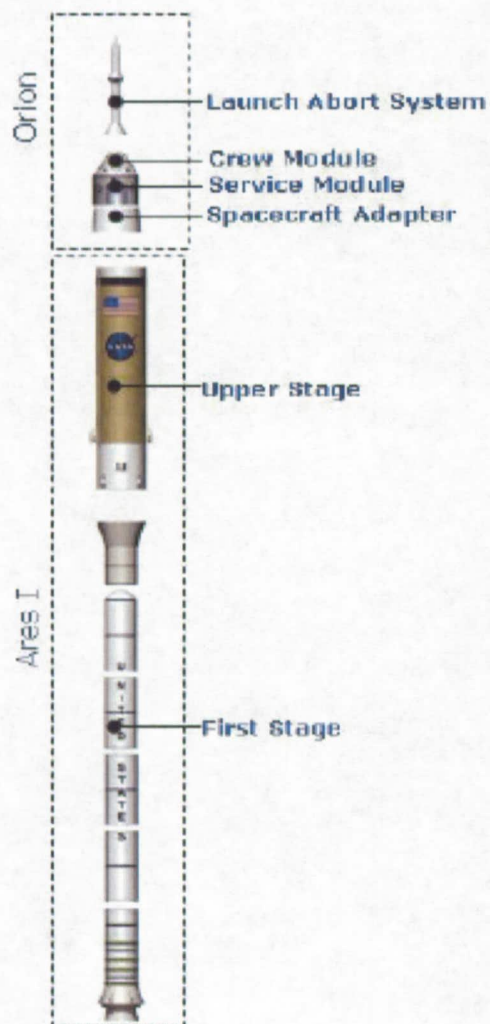


2018	2019		2020	
<div>Ares V-Y</div> <div></div> <div>Jun</div>	<div>LSAM 1</div> <div><div>Orion 13</div><div></div></div> <div>Dec</div>	<div>LSAM 2</div> <div><div>Orion 15</div><div></div></div> <div>Jun</div>	<div>LSAM 3</div> <div><div>Orion 17</div><div></div></div> <div>Dec</div>	<div>LSAM 4</div> <div><div>Orion 19</div><div></div></div> <div>Jun</div>

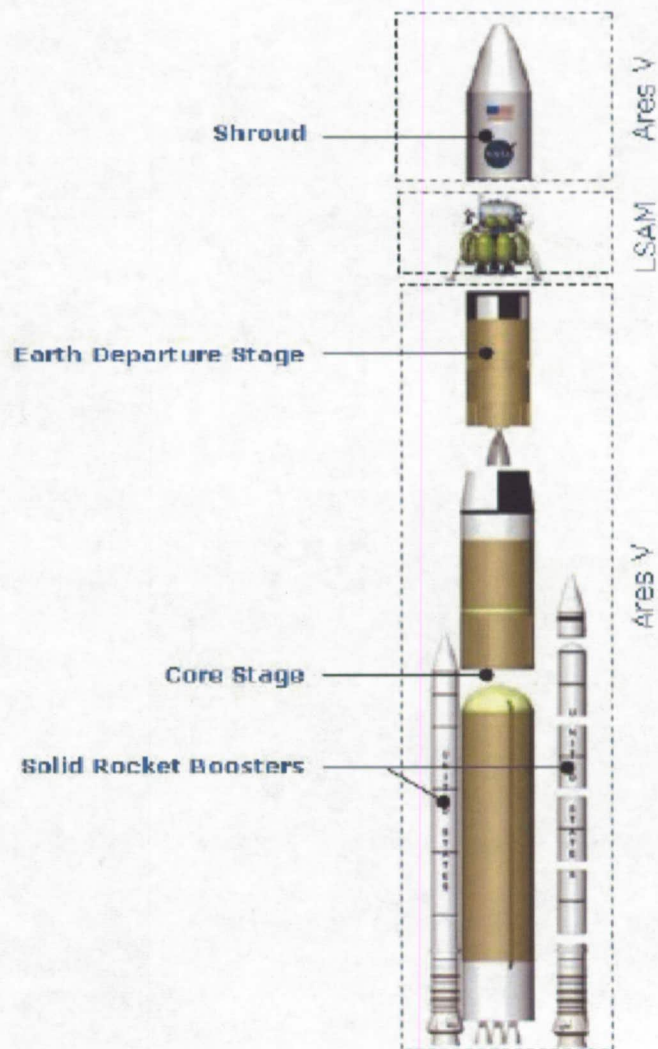


# Ares 1 and Ares V Ref. Configuration

## ARES I/Orion

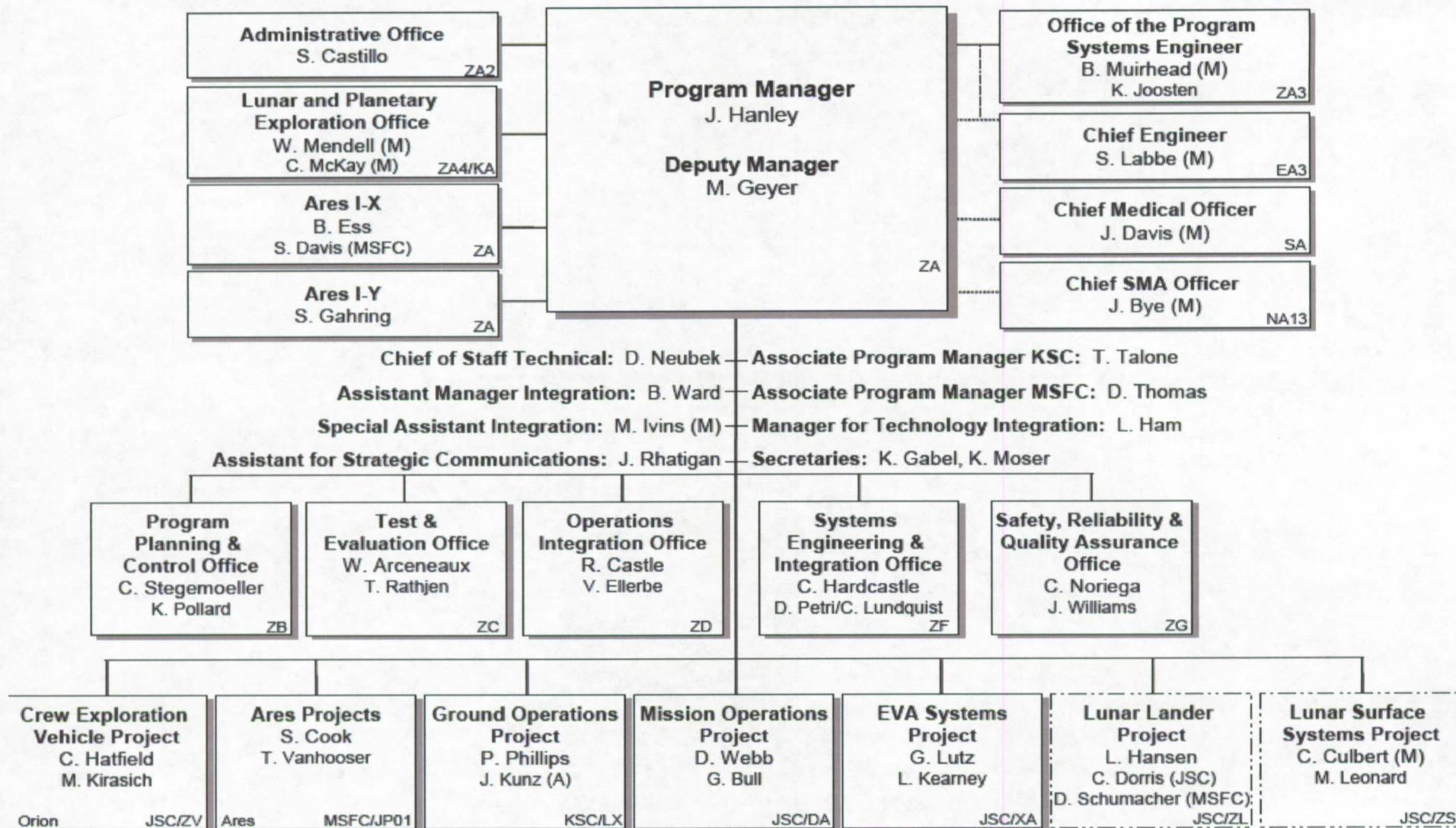


## ARES V/LSAM (Final Configuration TBD)





# Constellation Program



A- Acting  
M- Matrix  
--- Pre-Project

*Jeffrey M. Hanley*  
Jeffrey M. Hanley  
Manager

8/29/07  
Date





## KSC Responsibility for Constellation

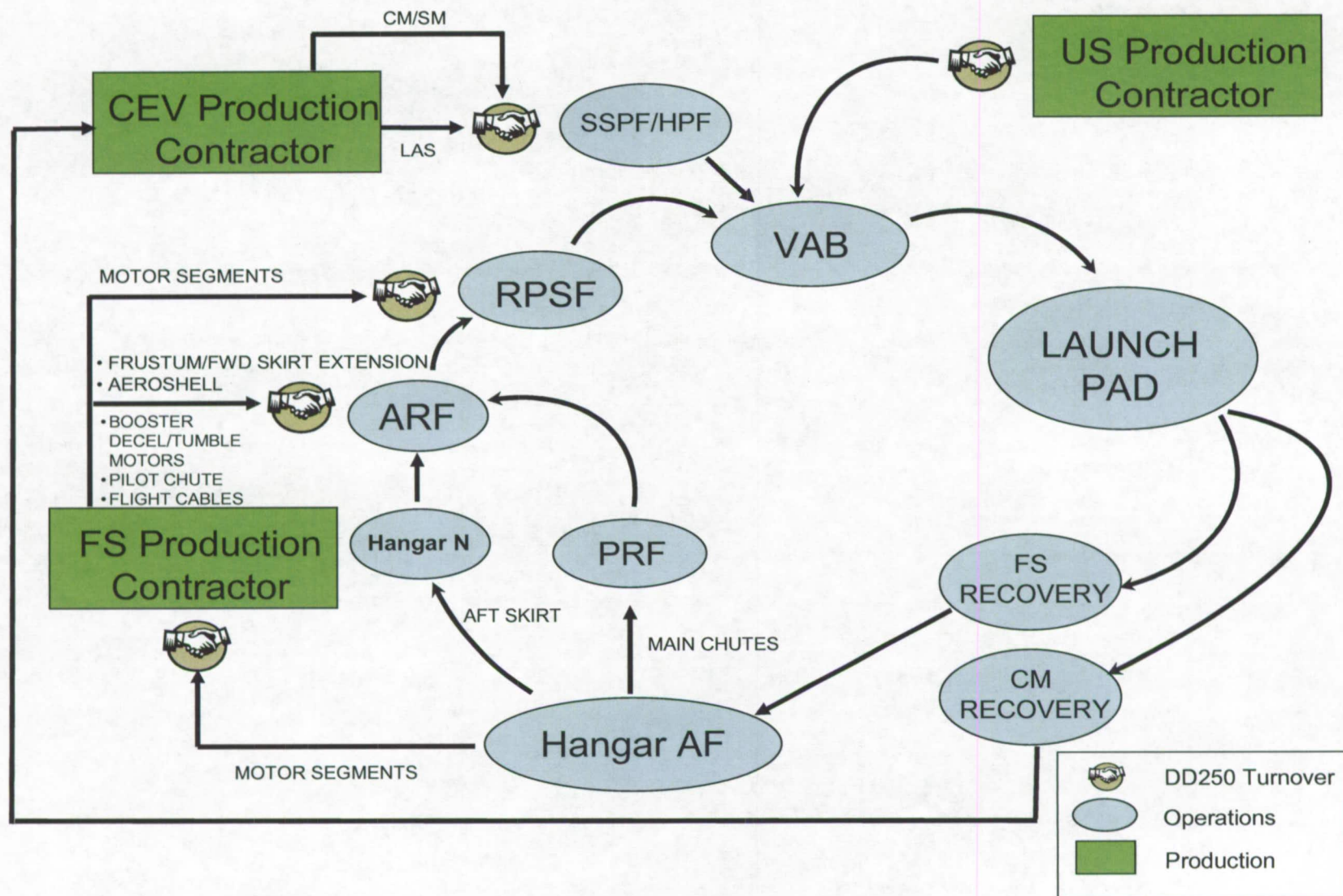


- ◆ **A Constellation Ground Operations Project Office is established at KSC, reporting directly to the Center Director. Responsible for the launch site development, ground processing and operations efforts at the launch, landing and retrieval sites in support of the Constellation Program. In addition the GO Project supports spacecraft and launch vehicle design for operability and interface definition to Ground Systems. (CxP 72120, GO Project Plan)**
  - Launch site development includes new and modified facilities, Ground Support Equipment (GSE), and launch processing planning efforts.
  - Ground Operations includes the collection of ground activities performed at the launch, landing and retrieval sites including receiving, ground processing, integration, integrated and interface testing, launch operations, recovery, de-integration, refurbishment, disposal, pad abort, and search & rescue operations.

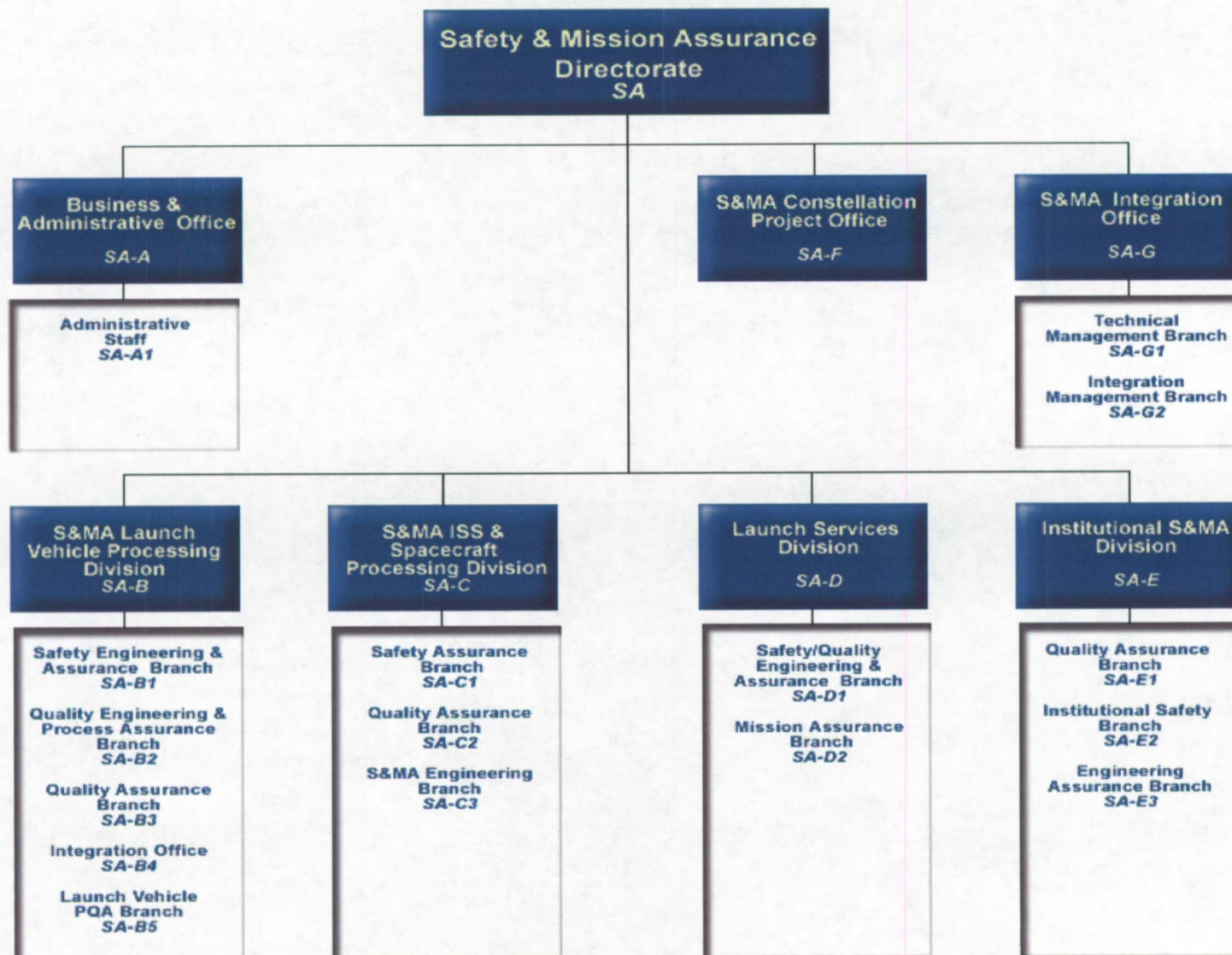


# Potential Ares 1/Orion

## GO Processing Flow



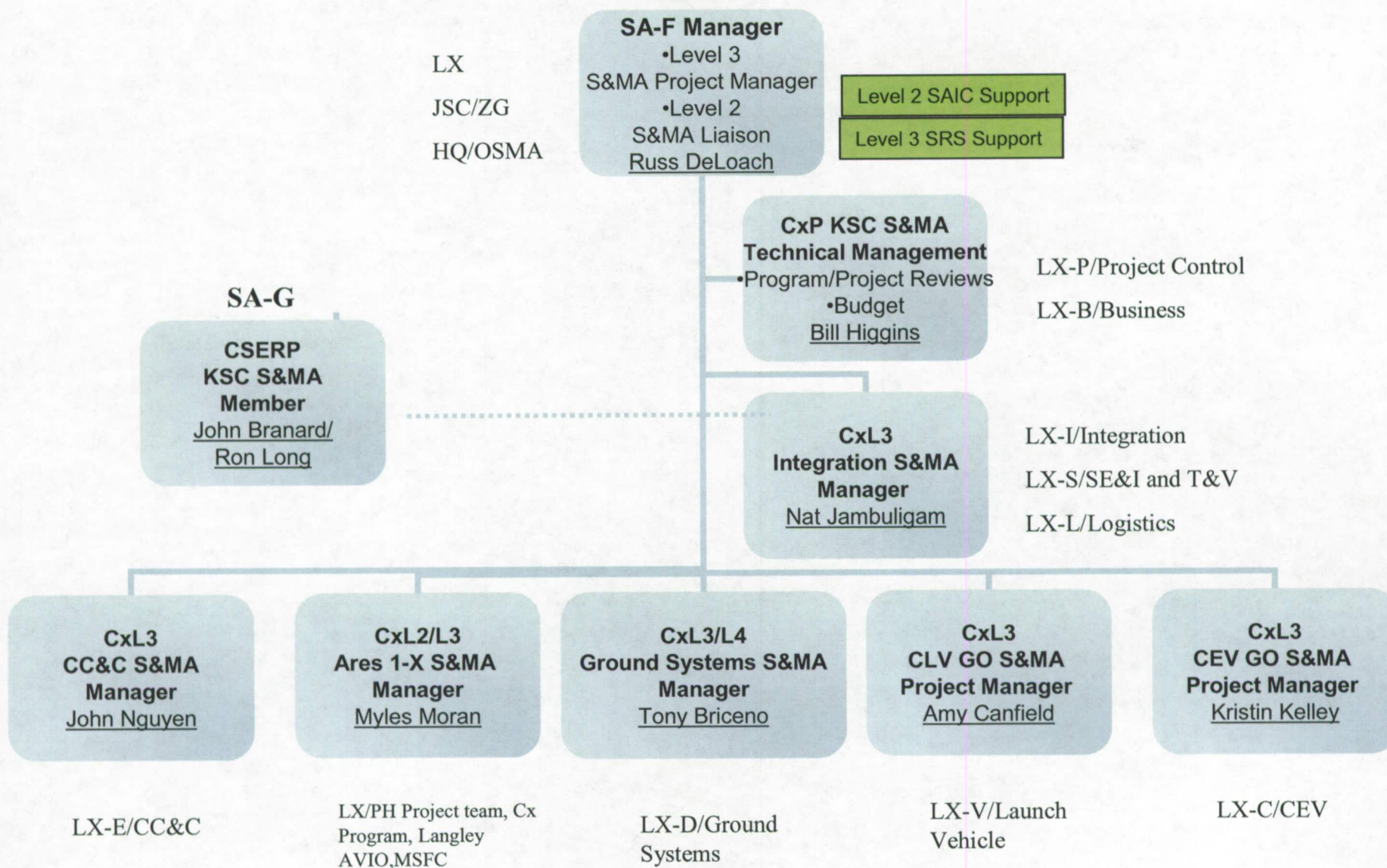
# KSC S&MA Organization



07-22-2007



# S&MA Constellation Project Office



# Program SR&QA Requirements

- ◆ CxP 70017 CxP Probabilistic Risk Assessment (PRA) Methodology
- ◆ CxP 70036 CxP Environmental Qualification & Acceptance Testing Requirements (CEQATR)
- ◆ CxP 70038 Methodology for Conduct of CxP Hazard Analyses
- ◆ CxP 70043 CxP Hardware FMEA/CIL Methodology
- ◆ CxP 70055 CxP SR&QA Plan
- ◆ CxP 70056 CxP Risk Management Plan
- ◆ CxP 70059 CxP Safety, Reliability, and Quality Assurance Requirements
- ◆ CxP 70068 PRACA Methodology for the CxP
- ◆ CxP 70087 CxP Reliability, Availability, and Maintainability Plan
- ◆ CxP 70128 Cx Software Assurance Plan
  
- ◆ **Management Directives**
  - MD003 Launch Cx Range Safety Panel
  - MD007 Charter for the CxP SR&QA Board
  - MD013 Charter for the Cx Safety & Engineering Review Panel (CSERP)
  - MD015 Charter for the CxP Quality Panel
  - MD017 Charter for the Cx Probabilistic Risk Assessment Panel (CPRAP)



# SR&QA Requirements of Interest

- ◆ **Probabilistic Risk Assessment “LOC/LOM”**
  - LOC < 1 in 100 for Lunar Sortie
  - LOM < 1 in 20 for Lunar Sortie
  - LOC < 1 in 1000 for ISS Crew Mission
  - LOM < 1 in 200 for ISS Crew Mission
- ◆ **Launch Availability**
- ◆ **Software S&MA**
- ◆ **Constellation Safety Engineering Review Panel (CSERP)**
  - Phased safety review of risk products rolled up to the Element level
  - CILs reported via Hazard Reports
- ◆ **AS9100B, Quality Management Systems, Aerospace Requirements**
- ◆ **Process Failure Mode and Effects Analysis applicable to manufacturing and operations**
- ◆ **Single PRACA system**
- ◆ **Continuous Risk Management, Top Risk Reviews**

# S&MA in Ground System Development

- The Ground System (Level III) is decomposed into Elements (Level IV), which are major divisions of functionality
- Each Element has a NASA Element Project Manager, assigned a budget to develop all ground and facility systems necessary to provide that functionality
- NASA S&MA assigned to support each Element.
- Design work is done at the Subsystem Level (Level V). The NASA Engineering Support Contractor (ASRC) is tasked to provide the S&MA products concurrent with the design as embedded members of subsystem project development teams. These S&MA products are reviewed and approved by NASA S&MA of corresponding Element.
- Deliverable to the CSERP is Element Hazard Reports. KSC continuing to develop process to roll Level V FMEA/CIL and Hazard Analysis products into required Program deliverable.

